"Is It Really Dead?" - Digging into Dead Brains through Analyzing Its Behavior in Response to Inducing External Impulses

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Background

Even though live brains are widely studied in the literature, dead brains remain little explored as perhaps it is generally believed to have a dead brain not workable anymore. In contrary to such general perception, in this work, we explore the possibility of making a dead brain work again. To be more precise, we explore outputs from a dead brain in response to applying external stimuli (in form of electrical signals) to it.

We perform several experiments following different approaches and analyze the outputs of a dead brain for various sets of inputs applied to it

Motivation

- Relatively scarce studies on detached brains, and the ethical concern of studies on alive animal brains have driven us to focus our research question into exploring the cranial nerves of dead goat brains.
- The motivation behind our experiment lies in the inquiry “Can a dead brain perform tasks or can we make a dead brain work?”
- In this study, we develop a setup with minimal cost to perform experiments to induce external signals and collect responses from dead brains in response to induced signals.
- Finally, we want to explore the possibility of manipulating dead brain to recognize patterns and to work as a memory unit.

Proposed Methodology

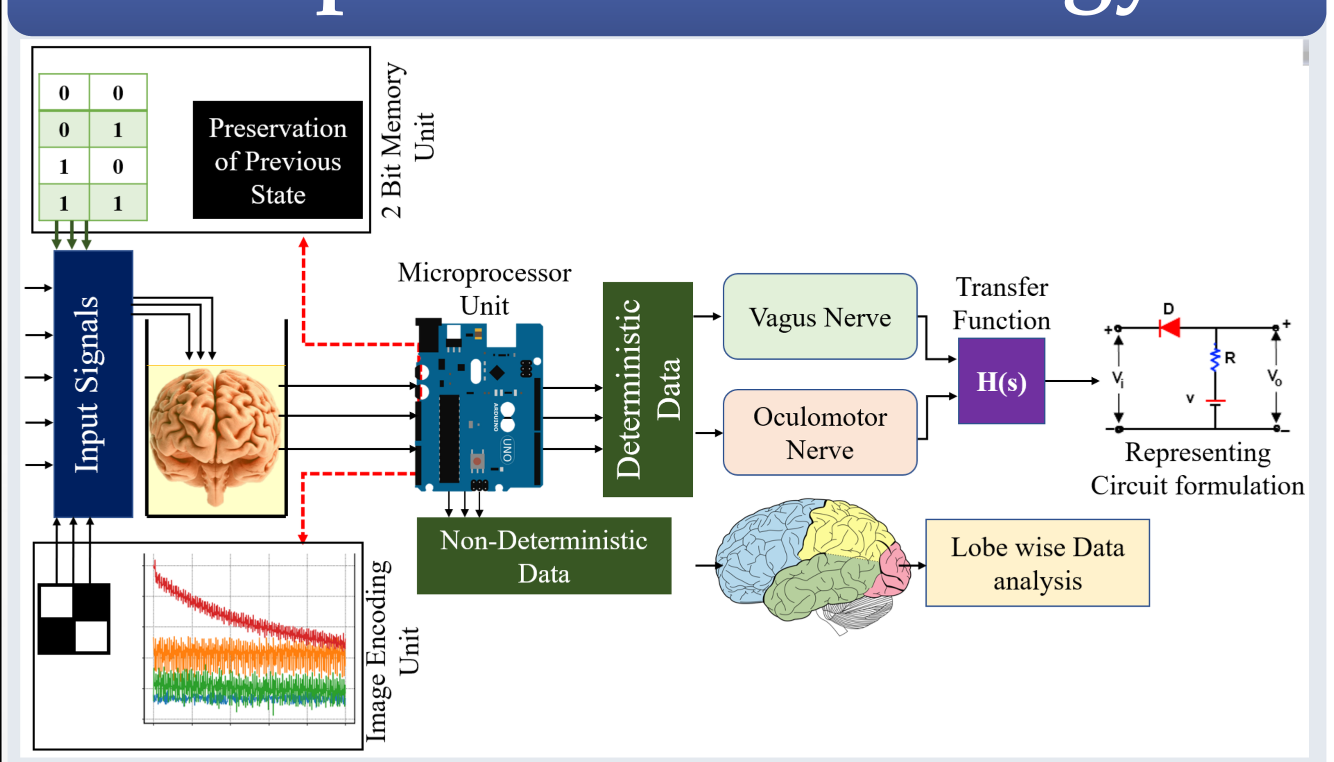

Figure 1: Basic layout of our experimental setup

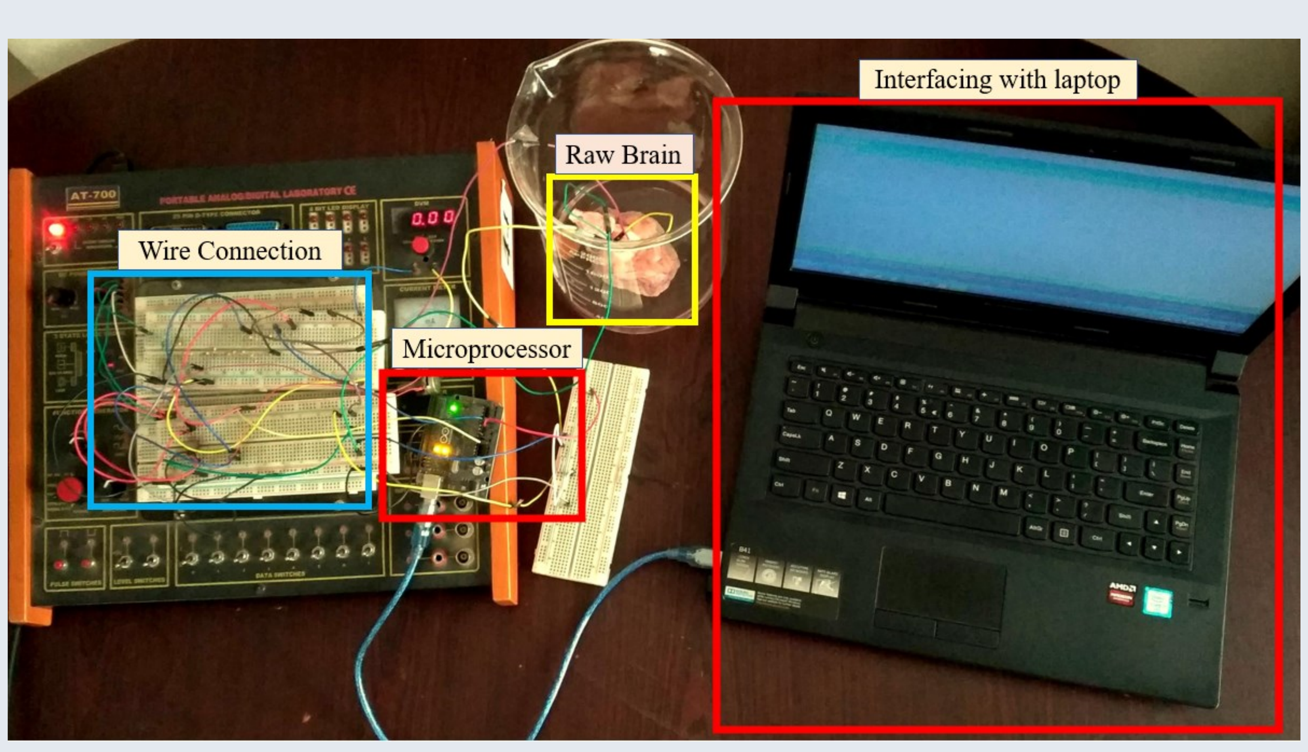

Figure 2: Final Experimental Setup

Experimental Study

- No deterministic results were obtained when data was collected from the four lobes of the brain

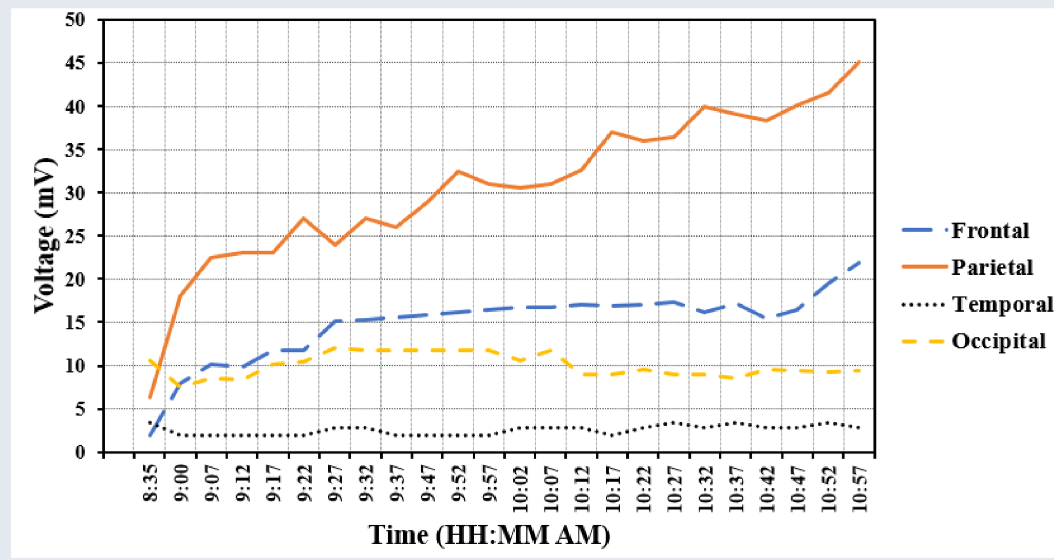

Figure 3: Voltage readings from different lobes over time

- Significant deterministic patterns in output reading were observed with external input signals at the optic nerve and taking output signals from Oculomotor and Vagus nerves.

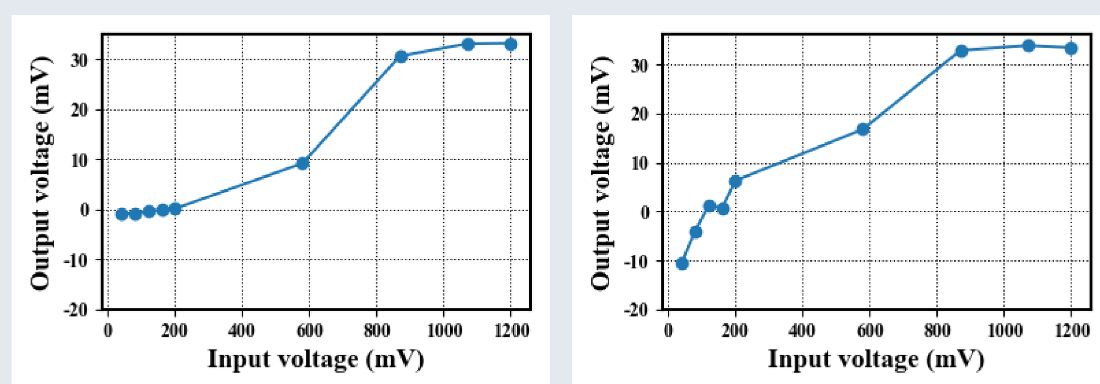

Figure 4: Reading from the vagus and oculomotor nerves

- The brain is fed with two different colors as two different voltage states. So far the experiments prove that the brain can detect these two colors with two different responses (voltage states).

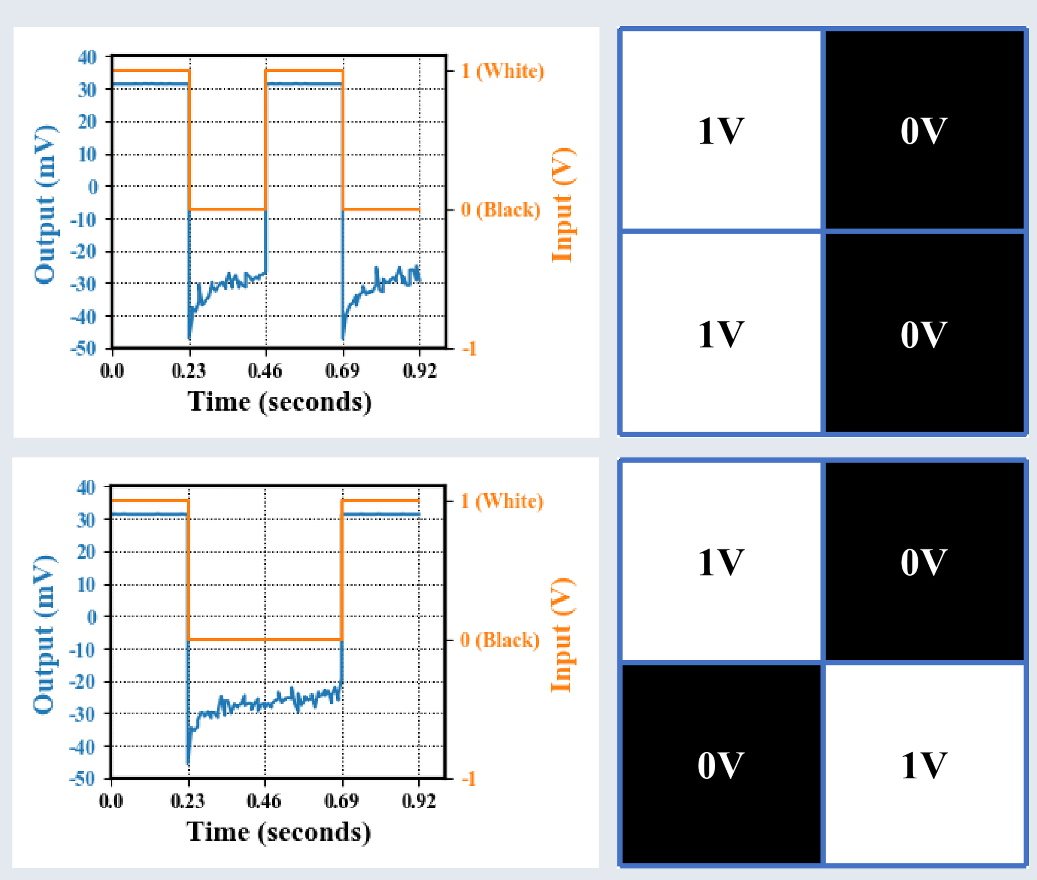

Figure 5: Comparison of the output signal in Vagus nerve and oculomotor nerve for input $(1010)_2$ and $(1001)_2$

- After applying external signals in 2 pins in the optic nerve, we collected output voltages from 4 pins, a pair each from the vagus and oculomotor nerves with all four permutations $(00)_2$,$(01)_2$,$(10)_2$,$(11)_2$

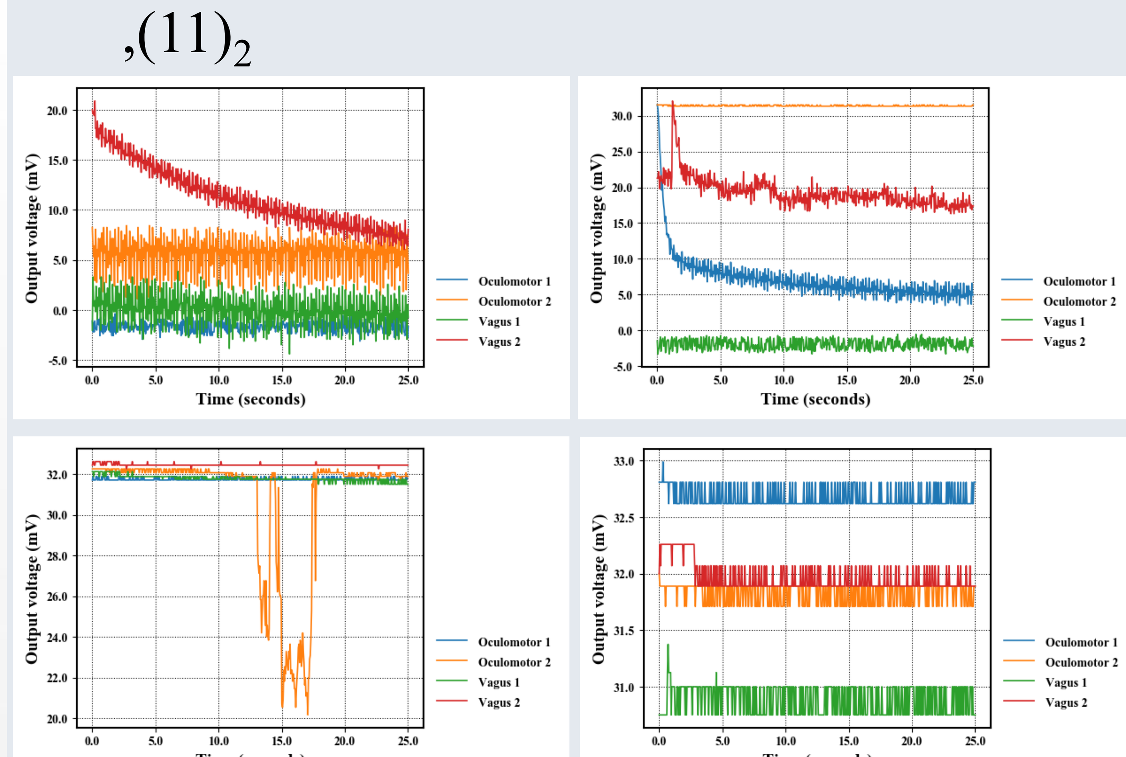

Figure 6: Output graphs for 2 bit inputs $(00)_2$, $(01)_2$, $(10)_2$, $(11)_2$

Findings

- If we inspect the input-output graph characteristics for vagus and oculomotor nerves, we can model them quite accurately using a positive clipper circuit.

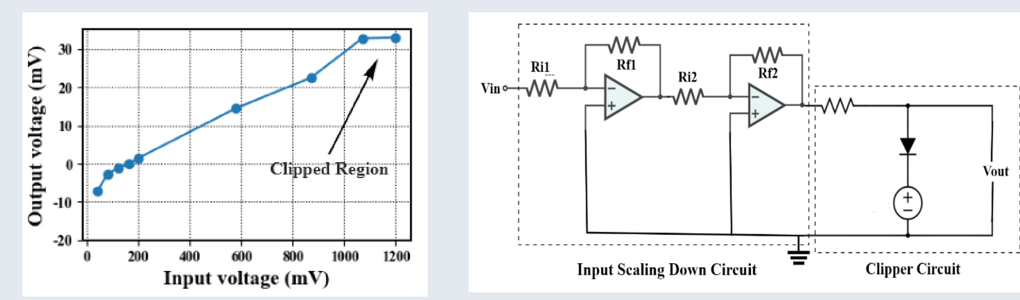

Figure 7: Transfer characteristics and proposed clipper model

- We perform polynomial regression for both the Vagus nerve and Oculomotor nerve to derive a representative transfer equation from the experimental data. For both the vagus and oculomotor nerves, a third-degree polynomial function provides promising outcomes

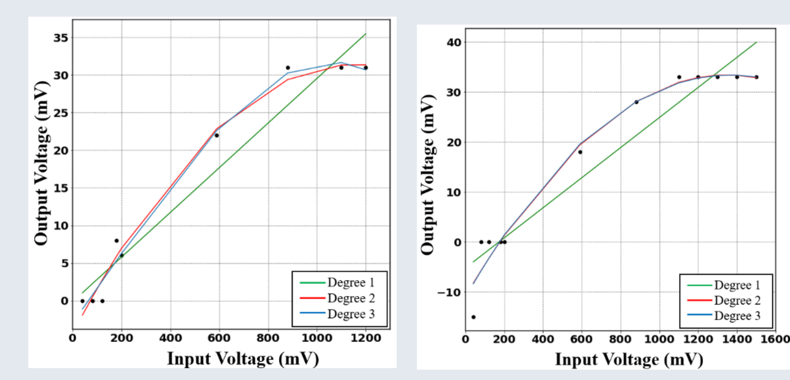

Figure 8: Polynomial curve fitting of Degree 1, 2, and 3 for the determined Transferred Equations

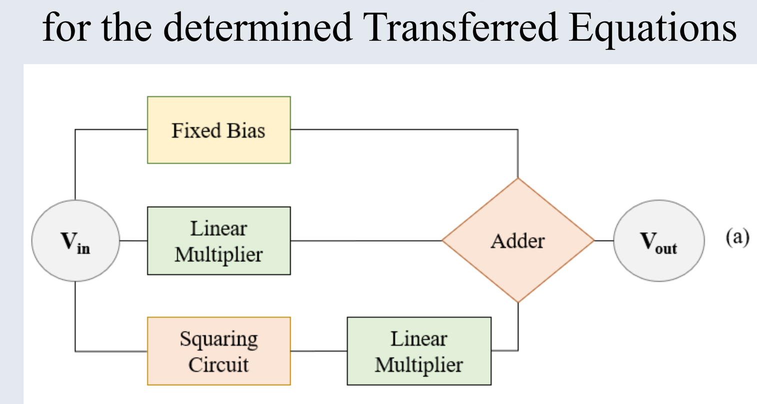

Figure 9:Representative circuit diagram of the derived transfer characteristics for second-order polynomial function

- Upon observing the pattern from Vagus and Oculomotor nerves , we define 1V and 0V as an encoding of two class labels: high and low, or white and black pixels, respectively. We use this encoding to detect black and white images from the output readings of the brain.
- From the 2-bit input study, we observe that most of the nerves retain their previous state, meaning that these nerves store the value they were given. From this observation, we can conclude that a detached brain may be used for storing and retrieving data.

Conclusion and Future Work

The prime goal of this study is to make a detached brain of a dead mammal work like an electrical processor, which is yet to be explored in the literature to the best of our knowledge.

In future, we want to explore more effective preservation method, increase the number of bits processed in parallel, investigate more input and output areas in road to explore the possibility of storing data in dead brains.

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